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AN ANALYSIS OF THE MARS CLASS COMBAT STORES SHIP TRANSFER AND CONVERSION PROGRAM

by

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December, 1995

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AN ANALYSIS OF THE MARS CLASS COMBAT STORES SHIP TRANSFER AND CONVERSION PROGRAM

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ABSTRACT

In 1990 the Chief of Naval Operations approved the transfer of the MARS class combat logistics force ships to the Military Sealift Command (MSC). Because MSC ships are manned with predominantly civilian crews, the total personnel assigned decreased from approximately 446 to 175 (135 civilian mariners and 40 military) resulting in an annual savings of $9.8 million per ship transferred. In this thesis we analyze the advantages and disadvantages of the transfer of the ships in terms of personnel and equipment. In addition, we expand upon a previously written computer simulation model that analyzes the effects and results of the newly installed material handling system to include the addition of the ship's flight deck.

TABLE OF CONTENTS

I. INTRODUCTION

A. PREFACE

Replenishment-at-sea has been one of the highest priority matters for the leaders of the United States Navy beginning in 1898 when Commodore Sohley commenced blockading the Spanish Fleet at Santiago in Cuba. This highly visible effort has continued up through the present in keeping the assigned aircraft carrier battle group at sea and ready to fulfill its mission in support of numerous United Nations and North American Treaty Organization operations including the civil war in the former Yugoslavia.

The U. S. Navy's aircraft carrier battle groups must stay at sea for long periods of time and must be ready to fight at a moment's notice. They are able to do that because the battle groups are replenished while underway with fuel, ammunition, stores, and provisions from a fleet of specialized cargo ships operated by both the Navy and the Military Sealift Command (MSC). The two methods of underway replenishment are vertical replenishment (VERTREP) and connected replenishment (CONREP). In general, customer ships are able to receive propulsion fuel, jet fuel, and stores during CONREP. Customer ships are able to receive stores during VERTREP as well. The method of delivery via CONREP or VERTREP is usually discussed and agreed upon before the ships actually come alongside one another.

In addition to the two methods of receiving material during the replenishment evolution, there are two methods of operating the Navy's logistics support force ships. The first method uses traditional Navy personnel while the second method uses civilian mariners (CIVMARS) who are managed by MSC. Prior to 1972, all of the Navy's combat logistics ships were manned and operated with active duty uniformed personnel. Over the last 23 years the Navy has transferred various classes of combat logistics force ships to the MSC. The principal reason that Navy ships have been transferred to the MSC is because it was thought to be less expensive because a civilian manned ship has a much smaller crew than one manned in the traditional Navy way.

During the Cold War, the United States was well on its way to its stated goal of having a 600 ship Navy. With the demise of the former Soviet Union, the Navy has had to reconsider its strategy with regard to the size of its operating forces. Presently the Navy is committed to an operating fleet of approximately 350 combatants. In light of an ever present political climate in which defense dollars are being traded for domestic programs, the Navy's force planners continue to strive to cut spending in as many areas as possible while trying to meet all of the Navy's mission requirements worldwide. At the same time, the Navy leadership desires to preserve its force structure when defense budgets are constantly being raided to fund non-defense programs and the military manpower pool is getting smaller.

In 1990 the Deputy Chief of Naval Operations (Logistics) asked the Center for Naval Analysis (CNA) to assess the potential cost savings of transferring combat logistics force (CLF) ships to the MSC to be operated by civilian crews and a small military detachment (MILDET). The study focused on the more quantifiable costs of operating CLF ships with civilian rather the military crews. These studies did not assess less quantifiable aspects of the transfer issue, such as crew endurance during wartime or under high-tempo peacetime operations. The cost to personnel in this case is difficult to measure. The reliability of civil service crews on ships that are placed under the operational control of the military is another effect of the transfer that is not easily measured. When men and women join the regular or reserve component of the Navy, there is an understanding that they may be called upon to go into a war zone and possibly get killed. During peacetime operations the enemy is not shooting and people tend to react differently in a stressful situation such as war. Another issue that was not addressed was that an active Naval vessel requires more personnel since it needs to operate and maintain all of the weapon systems which MSC ships do not have. Finally, the effect of this transfer on certain personnel programs such as the Women at Sea program and command opportunities for senior officers was not addressed. The Women at Sea program was brought into existence in the early 1980s to provide an avenue for qualified women to serve aboard Navy vessels which, until recently, was not a career path for women because of the statutes that did not allow women to serve on combatants.

The Chief of Naval Operations approved the transfer of MARS class shuttle logistics ships in October 1990. The transfer process began in 1992 and was completed in March 1995. This decision was based largely on the CNA study, estimated an annual cost savings of $9.8 million per ship transferred. The savings would be realized primarily in the reduction of crew size from 446 uniformed personnel under Navy manning requirements to approximately 184 personnel which includes a small detachment of an estimated 35 uniformed Navy personnel (CRM 90-130, June 1990).

One of the most applicable reasons that was cited to explain how the MSC is to operate the ships with such a greatly reduced (60% less) is given in the CNA report:

> The MSC is able to operate CLF ships with much smaller crews because skilled mariners are hired. One reason for higher manning levels on Navy vessels is that unskilled recruits must constantly be trained to replace more skilled sailors who spend only a few years in uniform.
> (Rost, Keenan, and Nelson, 1990, p. 7).

The transfer of the MARS class ships has been completed and the ships are currently undergoing extensive material handling and habitability upgrades. The upgrades include the installation of three 12,000 pound three pallet capacity elevators, which will improve the vertical lift capacity of the material handling system. This allows ship's personnel to fabricate and build unit loads (pallets) which is a critical path item in achieving the required transfer delivery rates. The habitability upgrades include removing the 30-80 person berthing compartments and replacing them with staterooms which service between one and six personnel. The USNS SAN JOSE (T-AFS-6) was one of the first of the class to receive the previously mentioned configuration modifications and was completed in February, 1995. USNS NIAGARA FALLS (T-AFS-3) is currently undergoing the conversion and is scheduled to return to the fleet in December, 1995.

B. THESIS PREVIEW

This objective of this thesis is to weigh the benefits, advantages, and disadvantages of the transfer and conversion program of these ships. The overall purpose of this project is to make a statement as to whether or not the project has been worthwhile to date. The primary benefit of this study to provide an additional tool to decisions makers in the execution of future programs. Additionally, this study can be used to evaluate the current program and improve upon it.

Chapter II provides a detailed discussion of the operational logistics environment in which CLF ships operate including current methodology and procedures. Chapters III and IV explain theoretical frameworks for making such decisions based on cost and performance data from the ships that have been transferred and converted. Chapter V concludes the thesis with a summary and offers recommendations for the program.

II. BACKGROUND

A. SHIPS OF THE COMBAT LOGISTICS FORCE (CLF)

The CLF fleet consists of approximately 50 ships that carry a wide array of commodities ranging from the Fleet Issue Load List (FILL) which consists of approximately 15,000 line items of frequently used spare parts and consumables to jet aircraft fuel. Table 1 illustrates types of ships in the CLF and the different commodities that are carried onboard the different types of ships.

Ship Type	FILL	HULL	SUB	FFV/ Diary	Ship's Store	F76	JP5	AO D/L	AMMO
TAFS	YES	YES	YES	YES	YES	NO	NO	NO	NO
AOE	NO	YES	YES	YES	NO	YES	YES	YES	YES
AOR	NO	YES	YES	YES	NO	YES	YES	YES	YES
AE	NO	NO	NO	NO	NO	YES	YES	YES	YES
TAO	NO	Y/N	NO	NO	NO	YES	YES	YES	NO
AO	NO	NO	NO	NO	NO	YES	YES	YES	Y/N

Table 1. Commodities Carried by Ship Type

Although this table shows that there are only six different types of ships in the CLF inventory, the types and configuration of what each ship carries in its holds varies substantially. These six types of ships fall into two categories: station ships and shuttle ships.

B. STATION SHIPS

Fast combat support ships (AOEs) and fleet replenishment oilers (AORs) are both considered station ships. The original Navy plan when building toward a 600 ship fleet was to have 15 aircraft carrier battle groups and one AOE or AOR to permanently travel with it. With the end of the Cold War and the constant pressure to decrease the Navy's budget, this plan has been abandoned. Station ships carry each of the three types of products that the Navy transfers from logistics ships to combatant ships at sea: petroleum products, subsistence and parts (stores), and ammunition. Both types of station ships have helicopter hangers and landing flight decks, since helicopters are used, along with other methods to ferry supplies between ships during re-supply operations. Station ships are also fitted with a variety of missiles, guns, and other defensive weapons. The ships were designed, in part, to defend themselves as well as provide some offensive firepower to aid the battle group.

The existing fleet of fast combat support ships is composed of four ships of the Sacramento class (AOE-1). These vessels were delivered to the Navy between 1964 and 1970. Each one of the ships displaces 53,600 tons when fully loaded. Fast combat support ships are capable of steaming at about 26 knots. This capability makes them a valuable asset to the battle group commander because the ships can keep up with the combatants and the battle group does not have to retreat to replenish. The ships have the capacity to carry approximately 177,000 barrels of petroleum products, 2,100 tons of ammunition, and 500 tons of stores. Congress authorized a new class of fast combat support ship, AOE-6, in fiscal year 1987. The first three of the four ships of the class are: USS SUPPLY (AOE-6), commissioned in February 1994, USS RAINIER (AOE-7), commissioned in January 1995, and USS ARCTIC (AOE-8), scheduled to be commissioned in late 1995. AOE-10, USS BRIDGE, is under construction at the time of this writing. The AOE-6 class ships have capacities similar to that of the AOE-1 class.

There are three remaining WITCHITA class fleet replenishment oilers (AOR) out of the original seven vessels built. These ships were delivered between 1969 and 1976 and are slightly smaller than the fast combat support ships. The fleet replenishment oilers displace 41,350 tons when fully loaded and their maximum speed is around 20 knots. Each ship carries about 170,000 barrels of petroleum products, 600 tons of ammunition, and 300 tons of stores. This class of ship also has a variety of offensive and defensive weapons that is similar to the AOE.

Two critical differences distinguish fast combat support ships from the fleet replenishment oilers. The AOR has less than one-third of the carrying capacity for ammunition of the AOE class of ship (600 tons compared with 2,100 tons). In addition, the fleet replenishment oiler is a slower ship compared with the fast combat support ship (20 knots compared to 26 knots). Both of these factors could play a significant role in how a battle group commander executes his war plan, because he may not have as much flexibility with regard to his replenishment.

C. SHUTTLE SHIPS

Three types of ships are included in the shuttle ship category: oilers (AOs and T-AOs), ammunition ships (AEs and T-AEs), and stores ships (T-AFSs). In contrast to the station ship concept, in which the ship carries all three general types of supplies (petroleum products, ammunition, and stores), the shuttle ships are designed to basically carry one of the three product types. In the Navy's concept of operations, the shuttle ship transports goods from land-based logistics depots and supply centers to the station ships, which in turn deliver the supplies to the battle group. The shuttle ships are also completely capable of transferring material to the customer directly, via connected or vertical replenishment. The method of replenishment depends on the time available, the amount of material to be transferred, and the desires of the receiving ship's captain, although each UNREP is conducted under the same general guidelines.

Currently, there are approximately 20 oilers in the Navy's inventory. There are three different classes of oilers ranging in displacement from 27,000 to 40,000 tons when fully loaded. The carrying capacity of these oilers varies between 120,000 and 180,000 barrels of petroleum products and their maximum speed varies from 16 knots to 20 knots, depending on the class.

The ammunition ships are designed to transport and transfer ammunition both to the customer ship that needs to re-arm as well as receiving ammunition from ships who have no immediate need for it, such as those ships going into an overhaul or upkeep status. Five SURIBACHI class ships were delivered to the Navy in the late 1950s and will reach the end of their expected service life later in this decade. Eight KILAUEA class ships were delivered to the Navy in the late 1960s and early 1970s. The ship's full load displacements are about 17,500 tons (SURIBACHI class) and 20,000 tons (KILAUEA class). Each ship carriers up to 6,500 tons of ammunition and the maximum speed is around 20 knots for both classes of ship.

There are eight of the original ten stores ships remaining in the CLF inventory. Of those the ships, seven are of the MARS class (AFS-1 thru AFS-7). The final three stores ships (AFS-8 thru AFS-10) were purchased from Great Britain. These vessels, also known as "Brit Boats," displace about 16,500 tons when fully loaded and their maximum speed is approximately 20 knots.

D. MARS CLASS STORES SHIPS

The MARS class combat stores ships were designed in the late 1950s and constructed by National Steel and Shipbuilding Company. The ships were commissioned between 1963 and 1970. All ships were originally designed with accommodations for 37 officers, 441 enlisted personnel, and six transient personnel for a total of 484.

Ship manning was sized and the cargo handling systems were designed to provide cargo breakout rates to sustain maximum connected replenishment transfer rates to an aircraft carrier to port and destroyer/frigate to starboard. Additionally, the maximum transfer rate included material transfer to a more distant customer ship via vertical replenishment. To support these high material transfer rates, numerous package conveyors, pallet conveyors, and elevators were installed to efficiently move cargo and stores from various hold locations to its CONREP or VERTREP station for further delivery to the customer ship. Table 2 shows a representative stowage arrangement for

	HOLD NUMBER				
LEVEL	1	2	3	4	5
2	FILL	DRY	CHILL	HULL	FILL
3	FILL	DRY	FREEZE	HULL	FILL
4	FILL	DRY	FREEZE	HULL	FILL
5		HAZMAT	CHILL	Ship's Store	

Table 2. Typical Commodity Location for T-AFSs

FILL (Fleet Issue Load List) material, HULL (High Usage Load List) material, and HAZMAT (Hazardous Material) broken down by hold and level for ships of the class. It is important to keep in mind that this is only a representative stowage plan and that over time modifications are incorporated into the original design.

While the original cargo handling design concept was intended to preclude the need for staging the cargo to be delivered, operational problems were experienced with the conveyors, and even with the appropriate personnel manned and ready, pre-staging pallets of materials in advance of meeting up with the customer ship was usually required. For example, the order of replenishment could change at the last minute. If the AFS is told that ship X is the first in line, their material is pre-staged closest to the flight deck or CONREP station. If the order changes after the material is pre-staged, then all of those pallets must be moved around in order to accommodate the new order.

MSC conducted a study to determine the actual cargo transfer rates for the pre-modification configuration of the AFS class of ships. The transfer rate is the key element in developing the new cargo handling arrangement based upon the fact that MSC mans its ships at a level that is smaller than the Navy's level. The number of pallets to be transferred drives the number of billets that are allowed on board the ship. The study concluded that the cargo transfer operation was significantly burdened by the existing arrangement of equipment which could only carry as many boxes or pallets as the cargo handlers could place on rotating trays. This resulted in package trays that were sent up to the main deck half empty because the handlers could not keep up with the speed of the conveyor equipment. Because of this, the actual transfer rate was approximately 50% of the system design rate (Procurement Management Plan, 1992). Table 3 illustrates the material handling configuration after the modifications and upgrade to T-AFS-7, USNS SAN JOSE. It is important to keep in mind that although all of the MARS class ships have been transferred to MSC, the range of modifications and habitability upgrades that each ship will finally receive will be somewhat different due to budget and other constraints. For example, the USNS NIAGARA FALLS (T-AFS-3) is not receiving any upgrades or modifications to Hold #1 and the elevators which service Holds 3 and 4 are rated at a capacity of 10,000 lbs.

Elevator Nbr	Hold/Location	Weight/Capacity	Unit Load	Decks Served
1	Hold #1/Aft	3,000 lbs	1 Pallet	4
2	Hold #2/Aft	3,000 lbs	1 Pallet	5
3	Hold #3/Fwd	12,000 lbs	3 Pallets	5
4	Hold #4/Aft	12,000 lbs	3 Pallets	4
5	Hold #5/Fwd	12,000 lbs	3 Pallets	3

Table 3. New Elevator Configuration for T-AFS-7

One of MSC's primary goals during the conversion is to return each ship to fleet support services on schedule and in a fully mission ready status which translates into improved customer service for the underway battle group. The final impact of the newly installed material handling equipment and the reduced manning in crew size is only now being seen as the ships have begun to return to service.

III. CARGO HANDLING AND PROGRAM CONVERSION

A. OVERVIEW

During a casual observation of an aircraft carrier battle group UNREP, an inexperienced or unseasoned observer may get the idea that the evolution is rather simplistic. On the contrary, nothing could be further from the truth. The actual transfer of one pallet of material, stores, or personnel from one ship to another is the culmination of a process that usually begins up to one month prior to the actual UNREP.

The difficulty in evaluating an ongoing program or simulated cargo handling plan that has been developed for a very wide range of scenarios lies in the fact that each ship and crew has determined its own best way to properly prepare for and conduct an UNREP. One such strategy that has been developed to conduct an UNREP is where the T-AFS crew breaks out as much material as is requested and stages it near the CONREP station several days before the replenishment. These strategies are based largely on the corporate knowledge of the ship's key personnel and the training process they receive during Refresher Training (REFTRA) or during inport and at-sea Ship Qualification Trials (SQT). Cargo handling plans and procedures have therefore evolved into the final product by way of an iterative process which is predominantly based on learning experience. At the time of this research, there is no concrete tool specifically designed to aid in planning for cargo handling operations. Navy Publication NWP-14 (Replenishment-at-Sea) is a mandatory shipboard manual and it is used as a tool that provides a listing of the general capabilities of UNREP equipment and detailed operating instructions for major pieces of UNREP equipment. NWP-14 does not, however, provide specific guidance and procedures for the conduct of an UNREP evolution. This publication does provide specific information with regard to expected transfer rates of the available equipment onboard various classes of ships. This information, along with descriptions of the various environmental conditions that have been experienced are useful in providing expected results of an UNREP. There are many environmental conditions that are major contributors to the length of time and the overall success of an UNREP. Five key factors that are known to impact underway replenishment operations are:

1. crew size of both the transferring and receiving ships
2. the number and type of receiving ships
3. sea state and the distance between the ships
4. number of pallets and commodity breakdown of those pallets
5. material condition of transfer equipment which includes fixed equipment such as winches and helicopters (prime movers)

This list focuses on the external movement of the material and is of little assistance when planning the material movement onboard a CLF ship. This is because the material movement that the CLF crew does before the UNREP begins is just as important if not more so. There is not a hard and fast way or "laundry check list" for the conduct of an UNREP. Neither is there a way to judge the success or failure of an UNREP.

B. PROCEDURES

The planning of an UNREP takes place on board both the receiving and transferring ship, but for our purposes we will concentrate on only the receiving vessel. Typically, a T-AFS does not provide service to its customers on an individual basis. The T-AFS is usually scheduled to replenish the entire battle group or sub-sections of it all at one time which usually takes most of a day. This is not always the case; an emergent replenishment may have to be conducted because of some unforeseen contingency such as a ship having to break off from the main battle group to conduct an exercise. This ship may not be able to replenish with the battle group and is scheduled by itself. Customer service is the main goal of MSC and they are extremely flexible in getting material and stores to the customer whenever and wherever it is needed. These scheduled and unscheduled replenishments are called "hits" and are scheduled by the Commander, Logistics Group, Western Pacific (COMLOGWESTPAC). The schedule is usually promulgated with specific instructions on how and when to requisition material.

An UNREP cycle usually begins 21-30 days in advance of the actual transfer of material. It is important to remember that all of these procedures are only guidelines and each replenishment evolution, also known as a “hit”, is different. For example, prior to a deployment, all of the battle group supply officers will meet with the T-AFS to discuss unique procedures that may apply to this deployment. These meetings also serve to allow all parties to get to know one another so that a smooth working relationship can be developed and maintained. A typical flow of events are listed below. The times following each step represent the time it takes to perform the step and are only estimates based on T-AFS personnel experience.

1. Requirements list received by T-AFS, usually by Naval message. The customer ship is continually in the process of developing requirements lists.

2. Customer lists are processed by T-AFS stock control personnel, if material is in stock or not in stock. (2-6 hours)

3. Each list is broken down by hold number and level where material is located for each customer. (2-6 hours)

4. Lists are given to T-AFS cargo personnel (CIVMARS). (1-2 hours)

5. Material is broken out and palletized by ship in order of replenishment. (1-7 days)

6. 100% of material is checked to ensure the correct material is going to the correct ship. (1-7 days)

7. Dry material/stores are brought to the main deck and positioned near the transfer point (flight deck for VERTREP/RAS station for CONREP). Fresh fruit, vegetables, and frozen remain in the reefer hold until just before replenishment to prevent spoilage. Pallets are built in the hold. (1-7 days)

8. Ships form up to begin the UNREP in the order that the battle group commander determines based on input from all parties. (12-48 hours)

The steps that we present in the above list are only one example of the evolution. Each T-AFS master has his/her own special experiences that are incorporated into the final product that make each UNREP evolution unique. Some of the steps listed could be performed concurrently to save time. For example, the checking of the material break outs can be checked before the all of the breakouts have been completed. The officer-in-charge of the military detachment, who is a Navy Supply Corps commander, works very closely with the master of the vessel as well as his counterpart in the CIVMAR crew. Both groups have to be intimately aware of how the other operates in order for the whole evolution to work well. To date this relationship has been very good. Prior to the transfer of these ships, all uniformed personnel onboard Naval vessels served under a line commanding officer. The potential for friction in changing the reporting senior from a military person to a civilian master was great. However, this did not happen and the spirit of cooperation that exists between the uniformed personnel and the civilian mariners is evident in all phases of logistics support.

C. UNREP EVOLUTION AS A SYSTEM

A successful UNREP is the integration of numerous parts that must work in complete concert in order for the overall goal to be achieved. With respect to cost, the two most important are the people/labor portion and the machinery portion. The people portion consists of uniformed and civilian personnel both ashore and afloat that do the planning, organizing, and execution of the UNREP. The machinery portion of the system consists of the forklifts, elevators and other material handling equipment that allow personnel to move hundreds of pallets of material during a single UNREP.

The transfer of the MARS class ships to MSC focused on two major areas. The first was personnel and its associated savings to the Department of Defense. The second area was the upgrades to the material handling system, specifically the addition of 12,000 lb, three pallet elevators to assist and increase the vertical lift capability of the vessels.

In order to make a statement as to the success of the program, these two areas will be discussed in greater detail.

D. MANNING BEFORE AND AFTER TRANSFER

In almost all organizations that exist today the greatest costs are usually those associated with labor. For example, approximately 35% of the Navy's annual budget each year is spent on personnel costs to include pay and allowances, retirement, and other benefits. Active duty Naval vessels are manned based on scenarios that would occur during wartime, not the functional mission of the ship. In addition to the professional duties that a uniformed personnel performs related to their rates, many personnel are also assigned collateral duties. For example, a Navy electrician spends a good deal of his time working on shipboard electrical systems, as well as performing planned and corrective maintenance on any number of electrical systems on board ship. He may also be assigned a very critical duty such as being a member of an inport or underway firefighting team. An example of a collateral duty which is not nearly so critical, but no less important is being a member of the menu review board. Table 4 lists the number of billets before and after the transfer to MSC. The actual number of personnel assigned to each ship may vary slightly.

Before	After	Eliminated	Total Savings
457	38	419	$17.3M

Table 4. Change in Personnel Billets (Rost, Keenan, Nelson, 1990)

The predominantly Navy crews are being replaced by civilian mariners. In addition to the extra manning that is to complete the required military taskings, the higher Navy manning can be attributed to the fact that unskilled personnel are hired and must be constantly trained to replace those who leave the service or are transferred. Civilian mariners tend to stay in MSC for longer periods. Another possible explanation of the increased manning levels is that the goal of the Navy personnel chiefs is to man ships and squadrons at a level that is required for conditions that are found in battle. Table 5 represents the number of civilian billets added and the cost associated with the transfer and conversion of the vessels. There is an $11.3 million potential personnel cost savings as a result of the transfer.

	Before Transfer	After Transfer	Annual Cost
Nbr of Civilian Personnel	0	135	$6.0 M

Table 5. Additional Billets. (Rost, Keenan, Nelson, 1990)

E. EQUIPMENT BEFORE AND AFTER TRANSFER

The second major portion of the conversion and transfer program is the major upgrade to the material handling capabilities of the ships. This included various elevator installations and habitability upgrades. The habitability upgrades that are taking place are mostly in the form of rearranging and reconfiguring the berthing areas. On board Navy vessels, enlisted personnel occupy berthing compartments which are capable of holding between 20 and 100 personnel depending on the type of vessel. MSC personnel are authorized more private living and berthing conditions which include one and two person staterooms.

There are also plans to keep at least one of the larger berthing compartments intact so it may be used for transient personnel that the T-AFS may be required to shuttle to and from the battle group.

The other half of the material portion of this program is the installation of various elevators on board the ships. Each ship is being converted by a variety of contractors and subcontractors at various shipyards throughout the country. Table 6 summarizes the estimated changes that have been scheduled.

Ship	Cost Est	Work Scheduled	Returns to Service
MARS (TAFS-1)	$20M	2-12 K Elevators	TBD
NIAGARA FALLS (TAFS-3)	$25M	2-12 K Elevators	Oct 95
CONCORD (TAFS-5)	$32M	2-12 K Elevators	Feb 96
SAN DIEGO (TAFS-6)	$30M	3-12 K Elevators	Sept 96
SAN JOSE (TAFS-7)	$24M	3-12 K/2- 3K	Complete

Table 6. Planned Equipment and Habitability Modifications

It is worthwhile to mention at this point that the order in which the ships are going into the availability is not the order in which they were commissioned. The availability schedule was based on the fleet requirements and the point in the maintenance cycle where each ship was at the time. This mammoth project has been in the planning stages since the mid 1980s. Although only one ship, USNS SAN JOSE, has been completed and returned to service for a relatively short period of time (April 95), we can now look at some of the results of the program and make assessments as to the degree of success as well as make recommendations with regard to the program in general.

IV. ANALYSIS OF PROGRAM

A. OVERVIEW

MSC has seven primary goals for the AFS transfer program. The seven goals are:

1. Complete a comprehensive and orderly life-cycle manager turnover with the NAVSEA Ship Logistics Manager (SLM), Puget Sound Naval Shipyard (Planning Yard), and COMNAVSURFPAC/LANT.

2. Complete a comprehensive and orderly logistics turnover with NAVSEA 04, NAVSUP, NAVSEACENPAC, and SPCC.

3. Complete a comprehensive and orderly turnover of each ship with the COMNAVSURFLANT/PAC designated commanders.

4. Complete a logistics review of each ship ensuring that an accurate configuration baseline as well as associated repair part, technical manual, and engineering drawing support is provided.

5. Reconcile and purify the AFS Fleet Issue Load List (FILL) material.

6. Complete each ship's turnover CIVMOD availability on time and within budget.

7. Return each ship to fleet support services on schedule and in a fully mission ready status. (Procurement Management Plan, 1992)

This chapter will critique the implementation of the program. The analysis is broken down into personnel issues and equipment issues.

B. PERSONNEL

The data on pay and allowances that were available from Hildebrand (1993), clearly show that from a labor cost perspective, this program has been and most likely will continue to be a tremendous success. There will be a substantial savings in the associated training as well. The most important advantage to the taxpayer is that fewer tax dollars will have to be spent on personnel wages when a ship is transferred from the Navy to MSC.

This labor savings does not come without a price. There are several possible affects that relate to the personnel issue as a result of the transfer of these vessels. First of all, when these billets are eliminated the personnel assigned to those billets may have a difficult time finding an assignment that is both beneficial to their personal desires as well as being good for the Navy. This affect is a short-term disadvantage because a billet can be dissolved relatively quickly but the body that held that billet will still be under an enlistment or officer contract for two to four years. The practice in the past has been to overstaff various commands until the normal attrition process brings the overall number of personnel back in sync with the number of billets available. This creates shortages at one command and excesses at another command which takes time to smooth out.

The second disadvantage is that while the ships belonged to the Navy, the Commanding Officers of those ships were prospective aircraft carrier commanding officers using the AFS as an opportunity to take command of a deep draft vessel. This tour allowed the captain to gain valuable experience prior to becoming an aircraft carrier commanding officer. Since those AFS billets are now gone, there are fewer deep draft ships available for almost the same number of available and eligible captains that are in the Navy. For example, if there were ten available billets and ten available and qualified officers and now there are only eight available billets the competition has just increase for a smaller number of billets. In this case, the issue is whether or not the Navy can provide a viable career path for prospective commanding officers. Again, these are short-term affects that will work themselves out as the Navy continues to "rightsize" through the remainder of the decade.

The third disadvantage relates to the level of combat readiness that has been given up as a result of the transfer of the MARS class ships. The main thrust of the data that has been collected and analyzed by both the Navy and MSC is mostly related to the traditional "bean counting". Clinton H. Whitehurst, Jr., of the American Enterprise Institute for Public Policy Research said the following (Hildebrand 1993):

> From the Navy's point of view, shifting some underway replenishment responsibility to MSC is a trade-off between dollar savings and combat readiness. With the Navy budget under increasing pressure; dollar savings have been favored. Navy officials, however, do not intend to shift the entire mission to MSC. In fact, many senior naval officers are concerned about the number of transfers that have already taken place. They fear that the savings obtained at the sacrifice of combat efficiency may prove to be a false economy in the long run, particularly in a wartime environment.

As previously mentioned, any existing self-defense armaments are removed when Navy logistics ships are transferred to MSC. In peacetime, operating logistics platforms through MSC has been more than satisfactory. For example, MSC ships played a key role in supporting the fleet in the Middle East during Operation Desert Shield/Storm. (Hildebrand 1993) Although Desert Storm was considered a war by most analysts, the logistics efforts were conducted with virtually no opposition. We feel that the Navy could rely on civilians during wartime if the logistics effort were opposed and the risk of being shot at were high. The men and women of both MSC and the Navy are of the highest caliber and although most have not been tested in battle, we feel their performance in those situations would be outstanding.

C. GENERAL EQUIPMENT PERFORMANCE

One of the methods that the Navy and MSC uses to measure and manage the readiness of their operational vessels is Casualty Reports (CASREPS). These reports are sent from the Commanding Officer/Master of the ship to various commands in and out of the ship's chain of command. A CASREP is sent when a piece of equipment fails and cannot be repaired by ship's force with on board repair parts within a reasonable amount of time, or when that equipment needs technical assistance that ship's force personnel cannot provide. The purpose of this message is to inform all concerned that a ship has some kind of a problem and its operational capability has been reduced. This information helps the battle group commander plan and conduct operations. Although all CASREPs are closely managed at all times, the management is increased to a higher level during a wartime scenario. The information contained in the remarks section of a CASREP message tells the battle group commander that one of his ships is unable to perform one or more of its assigned missions which in turn may force the battle plans to be altered.

There are three broad categories of CASREPS that are currently used by the Navy's surface fleet. A brief description of each follows:

1. C-2: A deficiency exists in a mission equipment which causes a minor degradation in any primary mission, or a major degradation of a secondary equipment/mission.

2. C-3: A deficiency exists in a mission essential equipment which causes a major degradation but no the total loss of a primary equipment/mission.

3. C-4: A deficiency exists in a missin essential equipment that is worse than casualty category 3, and causes a loss of at least one primary mission.

The assignment of the CASREP category is the responsibility of the Commanding Officer/Master of the ship. Advice and recommendations are solicited from the department head who actually owns the equipment. There is some subjectivity involved in the assignment of the CASREP category. What is viewed as "C-3" by one skipper may be seen as "C-2" by another. Most of this subjectivity is found in the assignment of CASREP categories for equipments and missions in the secondary area. There is rarely any discussion as to what the list of equipments and missions are that are directly related to the primary mission of a ship. For example, the inability of an aircraft carrier commanding officer to be able to launch aircraft because its catapults have failed is definitely in the "C-4" category. On the other hand, if a galley oven is down, a "C-2" category is assigned. The successful operation of the ship's galley is important, but a priority system is in place to assist the captain in the proper assignment of CASREP categories. This priority system is in place to ensure that the proper level of attention is directed to the proper shipboard equipment. The philosophy of the captain plays a substantial role in the determination of CASREP categories.

CASREP data for all ships, MSC as well as Navy, is collected and analyzed at the Ships Parts Control Center (SPCC) in Mechanicsburg, PA. This data is tracked and analyzed by civilian and military specialists who try to determine how to decrease the number of CASREPS fleet-wide. For example, if one ship of a class is sending in an inordinate number of reports, questions are asked about maintenance practices, operational scheduling, manning levels, etc. Another example would be the same weapon system or component failing on many different platforms. This scenario would cause the specialists at SPCC to look at the engineering design, repair part support, or a host of other factors to try to determine why that particular system is failing at a higher than expected level. Presumably, a decrease in CASREPS can be equated with an increase in fleet operational readiness. This point has been hotly contested for some time and is beyond the scope of this research. Table 7 is a summary of all reported CASREPS from AFS/TAFS ships from the period January 1989 to September 1995. A detailed breakdown per ship can be seen in Appendix D.

		CASREP Category					
Year	# of ships	2	3	4	Total	Ave/Month	Ave/Month/Ship
1989	8	306	24	5	335	28	3.5
1990	8	361	47	21	429	36	4.5
1991	8	270	17	8	295	25	3.1
1992	8	275	32	14	321	27	3.4
1993	8	302	29	11	342	29	3.6
1994	7	227	20	10	257	19	2.7
1995	7	144	8	7	159	12	1.7

Table 7. CASREPS reported by AFS/T-AFS

Taken by itself, the average number of reports submitted between 1989 and 1993 does not suggest anything concrete. Note that the total number of CASREPS does not make any distinction between those that require parts and those that require technical assistance. However, beginning in 1994 the average number CASREPS drops significantly.

Although the CNO approved the transfer of the MARS class ships in October of 1990, the process had only just begun. The upgrades to the habitability and material handling equipment had to be contracted for and implemented, as well as many other administrative details which had to be worked out. The actual availability period of each ship transferred from the Navy to MSC began in 1994. Before a ship goes into the conversion process there is normally a period of two or three months called a stand down during which the crew of the ship get ready for the transfer. Therefore, most of the equipment is not running and it generally does not breakdown. The potential for a casualty to occur in this period decreases substantially. During 1994 and 1995 the ships have been scheduled for the upgrades, and since they are not in service, the number of casualty reports has decreased. Another reason for the significant decrease is when the ships were transferred to MSC some of the Navy specific equipment and all of the weapon systems were removed. This means that the universe of equipments that could breakdown decreased. Finally, the decrease in reported casualties could be attributed to the fact that civilian masters command the ships instead of Navy captains. Because their backgrounds are generally different, their philosophies on reporting problems to their respective seniors may be different.

The maintenance philosophies of the Navy and MSC are somewhat different as well. The Navy has a well documented and established program of preventitive maintenance that at times literally forces management to perform scheduled maintenance. The operating tempo of Navy ships is sometimes so fierce that equipment is often pushed to its physical limits to find out when it will fail because in a battle situation, the captain must be aware of the upperbounds of his ship, equipment, and weapon systems. The punishment that Navy vessels take could account for the higher number of CASREPS reported until the ships were transferred to MSC. When the ships belonged to the Navy, they had a secondary warfighting mission. On the other hand, MSC does not expect to take its ships into battle and they tend to take a more evenhanded approach to equipment maintenance. All of the maintenance does indeed get performed, but the harsh and sometimes erratic operating conditions are not experienced by MSC which in turn could result in fewer equipment failures.

D. MATERIAL MOVEMENT TO CUSTOMERS

The overall mission of a T-AFS is to deliver subsistence and stores to the ships of an aircraft carrier battle group. The ship can also function as a personnel transfer platform as well as a shuttle service, bringing cargo and material from an ashore supply activity or depot to the fleet. The transfer and conversion process of the MARS class of ships is only partially complete and only one ship, USNS SAN JOSE has been completed and returned to service. SAN JOSE completed the conversion process with the installation of the new material handling system and habitability improvements and has been operating since in its new configuration was completed in February, 1995.

The ships of the CLF community produce a periodic report referred to as a Subsistence Transaction Report (STR). This management tool lists, by category, the types of commodities (chill, freeze, dry) that have been transferred to its customer ships. These reports are in the form of Naval messages which are transmitted to other CLF units that are operating in the same geographic area. These reports are also sent to COMLOGWESTPAC who is responsible for the overall scheduling of the TAFS ships. Since returning to service in March 1995, SAN JOSE has submitted 21 reports covering the period March through September 1995. Each report covers approximately 10 days, and reports are submitted as significant material transfers occur, not based on the passage of time.

Table 8 summarizes the average amount of material in tons that has been transferred by SAN JOSE to its customers since March 1995 per STR cycle.

Chill	Frozen	Dry	Total
7 Tons	27 Tons	42 Tons	76 Tons

Table 8. Average Subsistence Transferred per STR period

Taken by itself, this information only reveals how much material has been transferred with the new configuration. However, interviews with MSC and MILDET personnel indicate that the amount of material transferred before the transfer is comparable to the amount transferred while the ships were manned totally by Navy personnel. (Roberts, 1995) This lends credence to the fact that the changeover has been relatively invisible to the customer. This was one of MSC's primary goals when undertaking this project.

Another interpretation of this data is that the amount of material transferred is a function of the total amount of material requested by the customer ships. Underway ships are not forced to requisition material and supplies from the T-AFS. They can wait and order material from a supporting supply activity where the ship may be pulling into port for a visit. The ship may experience the situation where they do not need any material from the T-AFS although this is very unlikely.

E. SIMULATION ANALYSIS

A simulation model is a representation of a process or system that over time uses generated data to simulate the operation of the real system. The model is based on assumptions about the real system that are expressed as relationships between entities, objects of interest, which in this case are the pallets of material. After the SAN JOSE had completed the modification process, the officers and crew faced the significant challenge of operating a brand new system without the advantages of reviewing or testing reliable preliminary estimates of the new equipment and what effect the new configuration would have on the operation of the entire ship.

1. Review of previous study

An initial study (Fabish, 1994) was conducted to enable the ship to avoid a long and potentially painful learning experience which normally happens with new equipment and other systems. The study used a commercially available computer software simulation package to analyze the material handling system on board the SAN JOSE. The internal cargo handling features considered in this study were divided into two subsystems. The first involved the vertical movement of cargo from the holds to the main deck via the newly installed elevators. Once on the main deck, the material must be moved to designated RAS stations or other specified staging areas. The second subsystem looked at the delivery of material by forklift along the main deck.

2. Conclusions

The model was run over a variety of scenarios that included varying the number of forklifts, increasing and decreasing the speed of the elevator, and varying the time required to place and remove a pallet from the elevator platform. The study concluded that the overall success of the UNREP evolution is heavily dependent on the crew assigning two forklift trucks the job of removing pallets of material from the elevator platform and delivering them to the aftcargo staging area. From there the pallets are brought to the flight deck via another elevator. In addition, this study concluded that the narrow aisle that was created as a result of the elevator installation would require an increased level of coordination. Before the elevator installation two forktrucks could operate in the area whereas now only a single truck could operate in the narrow aisle. This conflict has been resolved by assigning a crewmember to act as a "traffic cop" to direct forktrucks in the area to prevent accidents and other unnecessary backlogs.

F. VALIDATION

To determine the realism of the computer simulation, interviews were conducted with shipboard personnel to compare the results of the various simulations with the actual performance of the new system. (Zagrocki, 1995) The interviews revealed that the forklift utilization was very close to what the initial study estimates provided. Although interviews can be somewhat subjective, MSC has no other formal process by which to judge to accuracy of this study. For example, it is hard to time the movement of pallets from the cargo holds to its final destination and that data was unable to be collected for this study. In addition, the study suggested that the new elevators would only be utilized approximately 35 percent when in fact the elevators are used almost constantly during the first half of the UNREP and then idle after bringing all of the material to the main deck. This happens because the freeze and chill cargo must stay in the refrigerated holds until just before delivery to the customer ship. Shipboard personnel stated that using two forktrucks, as was suggested by the initial study, significantly reduced the backlog to the point of being a non-factor in the overall UNREP evolution.

G. FLIGHT DECK OPERATIONS

Most ships prefer VERTREP instead of CONREP when receiving material while at sea. When the receiving ship is not connected to the supply ship the captain of the receiving ship is afforded a great deal of increased flexibility. This research expands on Fabish's original model by adding the flight deck and its associated staging areas. The model was run over a variety of scenarios and it was found that the length of time to complete the entire evolution only increased by the amount of time that was required to bring the pallets up from the aftcargo staging area to the flight deck. This result was expected. A backlog of pallets could not be created on the flight deck because of the limitations of the software. In other words, as soon as a pallet was brought to the flight deck, it was immediately picked up by a helicopter. The average time to complete the entire UNREP with the addition of the flight deck was 99.029 minutes. In addition, the average main deck utilization rate was 15 % which seemed somewhat low to those who were interviewed for this study. One possible explanation for this seemingly low utilization could lie in the limitations of the software that was used to perform the original simulation, which allowed a maximum of only 150 entities or pallets. In any UNREP that is conducted with three or more ships, at least 300 pallets of material are transferred

In the case of an UNREP involving an aircraft carrier, the number of pallets transferred can easily exceed 700 and the scenario with an aircraft carrier was not attempted. We feel, however, that even with these limitations, the results are valid. A sample of the output results can be seen in Appendix C. Table 9 summarizes the results of the addition of flight deck to the simulation model.

Scenario	Total Time	Main Deck Utilization
1 Helicopter/1 Forktruck	101 minutes	15%
1 Helicopter/2 Forktrucks	100 minutes	15%
2 Helicopters/1 Forktruck	98 minutes	16%
2 Helicopters/2 Forktrucks	97 minutes	16%
3 Helicopters/1 Forktruck	95 minutes	17%
3 Helicopters/2 Forktrucks	94 minutes	17%

Table 9. Summary of Simulation Results

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

In this thesis we analyze the transfer and conversion program of the MARS class combat stores ships to MSC. The objectives, advantages, and disadvantages are discussed and an attempt is made to make an overall statement regarding the program. Chapter II provides a detailed discussion of the operational environment in which CLF ships operate including current methodology and procedures. Chapter III discusses personnel and equipment configurations before and after the transfer. Chapter IV analyzed equipment performance of the new elevator configuration to date and also provided an extension of a previously written computer simulation model where a flight deck is added to the overall material handling system.

B. CONCLUSIONS

1. Personnel

This program was originally conceived so that the Department of Defense could save approximately $9.8 million per year per ship transferred. This savings is primarily achieved as a result of the reduction in crew size. There are, however, costs to personnel that are difficult to quantify. For example, many qualified and outstanding Navy captains may not have the opportunity to serve as commanding officers simply because there are not enough billets to go around.

Although the crews of these ships are now mostly civilian, there has been no change in perceived customer service to the operational battle groups. This was one of MSC's most important goals while working on this project.

2. Equipment

The new elevator and material handling equipment that has been installed on board USNS SAN JOSE has performed almost flawlessly since the ship returned to service in March 1995. To date, only routine, normal maintenance has been performed on the equipment and although this is a good sign, the real test will be to chart the maintenance history of the equipment as it begins to age. This additional information can then be used to further improve material handling capabilities. The new equipment has made the entire UNREP evolution much quicker and personnel have had to learn to think quicker on their feet than before. Previously, only one pallet at a time was coming up from the refrigerated holds and now they are coming up three at a time which greatly reduces the time to make a decision about where they need to go next before the next group of three pallets is sent from the holds. Although the small backlog of pallets waiting to be moved from the elevator staging area to the after cargo staging is annoying, it will always be present because of the increased vertical lift capability of the new elevators. We conclude here that the choice of equipment, installation, training, and operation was done with the highest standards and is being maintained and operated by outstanding personnel.

C. Flight Deck

The addition of the flight deck to the simualtion model only offered a slight decrease in the total time required to conduct the UNREP given the limitations of the software. The conclusion here is that the installation of the new elevator and other material handling equipment coupled with the existing flight deck capabilities has provided an improved material delivery system that is able to deliver palletized material to the battle group safely and at the least cost.

The major asset of the T-AFS flight deck is its helicopters. Most T-AFS ships deploy with an embarked helicopter squadron which has two CH-46 type helicopters. Almost all of the ships in the Navy's battle groups have a helicopter squadron on board when they deploy. This single helicopter can be used to retrieve material instead of the customer ship having to wait for their pallets to be delivered. This allows both the master of the T-AFS and the commanding officer of the Navy ship a greater degree of flexibility which is always welcome.

D. RECOMMENDATIONS FOR FURTHER STUDY

The transfer program is approximately 40% complete with two of the five ships (USNS SAN JOSE and USNS NIAGARA FALLS) now returned to the fleet. As the program continues to mature, additional historical maintenance data will become available. Additional analysis can be conducted on this new data and the long-term performance of the new material handling system can be assessed.

This, along with additional feedback from the operational commanders and afloat personnel, will allow the overall program to be assessed and more accurately shaped to meet an ever changing financial and political environment.

APPENDIX A. LIST OF ACRONYMS

CASREP	Casualty Report
CIVMARS	Civilian Mariners
CLF	Combat Logistics Force
CNA	Center for Naval Analysis
CNO	Chief of Naval Operations
CONREP	Connected Replenishment
MILDET	Military Detachment/Department
MSC	Military Sealift Command
NWP	Naval Warfare Publication
RAS	Replenishment at Sea
REFTRA	Refresher Training
USNS	United States Naval Ship
VERTREP	Vertical Replenishment

APPENDIX B. SOURCES OF SUPPLY FOR DEPLOYED UNITS

SHIP	FILL	HULL	SUB	FFV/D	SS	F76	JP5	L/O	AO D/L	AMMO	SODA
TAFS-1	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-3	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-5	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-6	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-7	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-8	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-9	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
TAFS-10	Y	Y	Y	Y	Y	Y	N	N	N	N	Y
AOE-1	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
AOE-2	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
AOE-3	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AOE-4	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AOE-6	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AOR-4	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AOR-6	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AOR-7	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y
AE-21	N	N	N	N	N	N	N	N	N	Y	N
AE-22	N	N	N	N	N	Y	N	N	N	Y	N
AE-23	N	N	N	N	N	N	N	N	N	Y	N
AE-24	N	N	N	N	N	Y	N	N	N	Y	N
AE-25	N	N	N	N	N	Y	N	N	N	Y	N
AE-27	N	N	N	N	N	Y	N	N	N	Y	N
AE-28	N	N	N	N	N	Y	N	N	N	Y	N
AE-29	N	N	N	N	N	Y	N	N	N	Y	N
AE-32	N	N	N	N	N	Y	N	N	N	Y	N
AE-33	N	N	N	N	N	Y	N	N	N	Y	N
AE-34	N	N	N	N	N	Y	N	N	N	Y	N
AE-35	N	N	N	N	N	Y	N	N	N	Y	N
TAE-26	N	N	N	N	N	Y	N	N	N	Y	N
TAO-146	N	N	N	N	N	Y	Y	Y	Y	N	Y

TAO-187	N	Y	N	N	N	Y	Y	Y	Y	N	Y
TAO-188	N	Y	N	N	N	Y	Y	Y	Y	N	Y
TAO-189	N	Y	N	N	N	Y	Y	Y	Y	N	Y
TAO-190	N	N	N	N	N	Y	Y	Y	Y	N	Y
TAO-193	N	N	N	N	N	Y	Y	Y	Y	N	Y
TAO-194	N	N	N	N	N	Y	Y	Y	Y	N	Y
TAO-195	N	Y	N	N	N	Y	Y	Y	Y	N	Y
TAO-196	N	Y	N	N	N	Y	Y	Y	Y	N	Y
TAO-197	N	N	N	N	N	Y	Y	Y	Y	N	Y
TAO-198	N	Y	N	N	N	Y	Y	Y	Y	N	Y
AO-177	N	N	N	N	N	Y	Y	Y	Y	N	Y
AO-178	N	N	N	N	N	Y	Y	N	Y	Y	Y
AO-179	N	N	N	N	N	Y	Y	N	Y	Y	Y
AO-180	N	N	N	N	N	Y	Y	Y	Y	N	Y
AO-186	N	N	N	N	N	Y	Y	N	Y	Y	Y

Source: NAVSUP Pub P-4998, Consolidated Afloat Requisitioning Guide Overseas

APPENDIX C. SIMAN PROGRAM ADAPTATION

A. MODEL CODE

This computer simulation program simulates material movement from the cargo holds to the flight deck.

```
BEGIN; Kelly J. Grosskopf, 1 December 1995

startup     ASSIGN: ns=Origin:   !assigns seqence number
            M=Origin:            !assigns initial station
            Grqty=GroupQty;      !assigns # pallets in L

            BRANCH,1:
                    IF,GroupQty.gt.1,multilift:
                    ELSE,picklift;

multilift   QUEUE,GroupQ;        for Multi load embelishment
            GROUP:Grqty;

picklift    BRANCH,1:
                    IF,Origin.LT.5,getlift3:
                    IF,Origin.LT.10,getlift4;

getlift3    QUEUE, Lift3Q;       Sequence to rqst Lift3
            REQUEST:Lift3;
            TRANSPORT: Lift3,SEQ,100;

getlift4    QUEUE, Lift4Q;       Sequence to rqst Lift4
            REQUEST:Lift4;
            TRANSPORT: Lift4,SEQ,10;

send        BRANCH,1:
                    IF,Origin.LT.5,sendlift3:
                    IF,Origin.LT.10,sendlift4;

sendlift3   DELAY:ED(13);
            TRANSPORT: Lift3,SEQ,100; Sends lift onward from hold

sendlift4   DELAY:ED(13);
            TRANSPORT: Lift4,SEQ,100; Sends lift onward from hold
```

```
          STATION, 1-8;              HOLD #3-#5,
          QUEUE, M;
          ASSIGN:Timein=TNOW;        [Mark beginning of flowtime]
          SEIZE: ForkTrk(M);         [Utilization of Hold3x Flift]
          DELAY:ED(GroupQty);        [Time to load Lift3]
          RELEASE:ForkTrk(M):NEXT(send); [Send Lift3 to main deck]
          STATION, MdatL3;           [Main deck L3 unloading routine]
          QUEUE,unload3Q;            [Contol Trk for unloading]
          SEIZE: ForkTrkL3;
          ASSIGN:TestQty3=GroupQty;
          BRANCH,1:
               IF,GroupQty.gt.1,split3SEQ:
               ELSE,unload3;

split3    SEQ SPLIT:M;               [for multi pallet loads only]

unload3   QUEUE,unload3Q1;
          SEIZE: Equip3;             [Temp asset to control flow]
          DELAY:ED(4+GroupQty-TestQty3)*.4; [Time to pull Pallet from L3]
          QUEUE,L3StageQ1;
          SEIZE:L3Staging;
          DELAY:ED(4+GroupQty-TestQty3)*.2; [Time in control of stage area]
          RELEASE:L3Staging;
          DELAY:ED(4+GroupQty-TestQty3)*.4;     [Time to move towards L3]
          ASSIGN: TestQty3=TestQty3-1;
          BRANCH,1:
               IF,Nq(Unload3Q1).eq.0,LetgoL3:
               ELSE,Moveon3;

LetGoL3   FREE:Lift3;           [Lift free to move since empty]
          RELEASE:ForkTrkL3;

Moveon3   RELEASE:Equip3;
          COUNT:Hold3_Count;         Pallet count out of hold3
          ASSIGN: NS=9:              !Reset all NS for 2nd transporter
          IS=1;
          ROUTE:0,L3Stage;

          STATION, L3Stage;
          QUEUE, ForkTrkAft3Q;       Q for delivery to RASsta
          ALLOCATE: FTruckMD3(SDS,FTruck#);
```

```
ChkPos3    BRANCH,1:
                IF,M.eq.11.and.LT(FtruckMD3,FTruck#).eq.11,Load3:
                IF,M.eq.11.and.LT(FtruckMD3,FTruck#).ne.11,ToL3;

ToL3       BRANCH,1:
                IF,M.eq.Fwd1Lane,onward3:
                ELSE,ToL3comp;

onward3    ASSIGN:MDFTSpeed= ED(7);
           MOVE:FtruckMD3(FTruck#),L3Stage,MDFTSpeed:
           NEXT(Load3);

ToL3comp   ASSIGN:MDFTSpeed=ED(10);
           MOVE:FtruckMD3(FTruck#),Aft1Lane,MDFTSpeed;
           QUEUE, Aisle3Q1;
           SEIZE: Naisle;              Narrow Aisle
           ASSIGN:MDFTSpeed=ED(9)*.8;
           MOVE:FtruckMD3(FTruck#),Fwd1Lane,MDFTSpeed;
           RELEASE:NAisle;
           ASSIGN:MDFTSpeed=ED(7);
           MOVE:FtruckMD3(FTruck#),L3Stage,MDFTSpeed:NEXT(load3);

Load3      BRANCH,1:
                IF,M.eq.11,GetAisle3:
                ELSE,Dest3;

GetAisle3  QUEUE,L3StageQ2;
           SEIZE:L3Staging;            [Occupy the stagging area]
           DELAY:ED(12);
           RELEASE:L3Staging;
           ASSIGN:MDFTSpeed=ED(7);
           MOVE:FtruckMD3(FTruck#),Fwd1Lane,MDFTSpeed;
           QUEUE,Aisle3Q3;
           SEIZE:NAisle;
           ASSIGN:MDFTSpeed=ED(9)*.8;
           MOVE:FTruckMD3(FTruck#),Aft1Lane,MDFTSpeed;
           RELEASE:NAisle;
Dest3      ASSIGN:MDFTSpeed=ED(10);
           TRANSPORT:FTruckMD3(FTruck#),SEQ,MDFTSpeed;

           STATION, MdatL4;            [Main deck L3 unloading routine]
```

```
                QUEUE,unload4Q;            Contol Trk for unloading]
                SEIZE: ForkTrkL4;
                ASSIGN:TestQty4=GroupQty;
                BRANCH,1:
                        IF,GroupQty.gt.1,splitSEQ4:
                        ELSE,unload4;

splitSEQ4       SPLIT:M;            [for multi pallet loads only]

unload4         QUEUE,unload4Q1;
                SEIZE: Equip4;       [Temp asset to control flow]
                DELAY:ED(4+GroupQty-TestQty4)*.4; [Time to pull Pallet from L3]
                QUEUE,L4StageQ1;
                SEIZE:L4Staging;
                DELAY:ED(4+GroupQty-TestQty4)*.2;  [Time in control of stage area]
                RELEASE:L4Staging;
                DELAY:ED(4+GroupQty-TestQty4)*.4;  [Time to move towards L4]
                ASSIGN: TestQty4=TestQty4-1;
                BRANCH,1:
                        IF,Nq(Unload4Q1).eq.0,LetgoL4:
                        ELSE,Moveon4;

LetGoL4         FREE:Lift4;            [Lift free to move since empty]
                RELEASE:ForkTrkL4;

Moveon4         RELEASE:Equip4;
                COUNT:Hold4_Count;         Pallet count out of hold3
                ASSIGN: NS=10:             !Reset all NS for 2nd transporter
                IS=1;
                ROUTE:0,L4Stage;
                STATION, L4Stage;
                QUEUE, ForkTrkAft4Q;       Q for delivery to RASsta
                ALLOCATE: FTruckMD4(SDS,FTruck#);

ChkPos4         BRANCH,1:
                        IF,M.eq.12.and.LT(FtruckMD4,FTruck#).eq.12,Load4:
                        IF,M.eq.12.and.LT(FtruckMD4,FTruck#).ne.12,ToL4;

ToL4            BRANCH,1:
                        IF,M.eq.Fwd1Lane,onward4:
                        ELSE,ToL4Comp;
```

```
onward4     ASSIGN:MDFTSpeed=ED(8);
            MOVE:FtruckMD4(FTruck#),L4Stage,MDFTSpeed:
            NEXT(Load4);
ToL4comp    ASSIGN:MDFTSpeed=ED(10);
            MOVE:FtruckMD4(FTruck#),Aft1Lane,MDFTSpeed;
            QUEUE, Aisle4Q1;
            SEIZE: NAisle;Narrow Aisle
            ASSIGN:MDFTSpeed=ED(9)*.8;
            MOVE:FtruckMD4(FTruck#),Fwd1Lane,MDFTSpeed;
            RELEASE:NAisle;
            ASSIGN:MDFTSpeed=ED(8);
            MOVE:FtruckMD4(FTruck#),L4Stage,MDFTSpeed:NEXT(load4);
Load4       BRANCH,1:
                    IF,M.eq.12,GetAisle4:
                    ELSE,Dest4;
GetAisle4   QUEUE,L4StageQ2;
            SEIZE:L4Staging;[Occupy the stagging area]
            DELAY:ED(12);
            RELEASE:L4Staging;
            ASSIGN:MDFTSpeed=ED(8);
            MOVE:FtruckMD4(FTruck#),Fwd1Lane,MDFTSpeed;
            QUEUE,Aisle4Q3;
            SEIZE:NAisle;
            ASSIGN:MDFTSpeed=ED(9)*.8;
            MOVE:FTruckMD4(FTruck#),Aft1Lane,MDFTSpeed;
            RELEASE:NAisle;
Dest4       ASSIGN:MDFTSpeed=ED(10);
            TRANSPORT:FTruckMD4(FTruck#),SEQ,MDFTSpeed;
            STATION, Fwd1Lane;
            STATION, Aft1Lane;
            STATION, FreeTrk3;
            DELAY: ED(11);                  Time to unload at AftCargo
            FREE: FtruckMD3(FTruck#);       Free Flift for next pallet
            ROUTE: 0,Aftcargo;

            STATION, FreeTrk4;
            DELAY: ED(11);Time to unload at AftCargo
            FREE: FtruckMD4(FTruck#);       Free Flift for next pallet
            TALLY: 2,tnow;
            ROUTE: 0,Aftcargo;
```

```
            STATION,Aftcargo;
            QUEUE, AftCargoQ;
            SEIZE: AftStage;
            DELAY: 0;
            COUNT: AftCargo_count;
            RELEASE:Aftstage;
            QUEUE, FDEQ;
            SEIZE: FDE;
            DELAY: TRIA(1,3,5);      Delay to load, move to FDeck, unload
            RELEASE: FDE;
            QUEUE, FDQ;
            SEIZE: HELO;
            DELAY: UN(1,3);          Helos arrive to pick up pallets
            RELEASE: HELO;
            TALLY: 2,TNOW;
            COUNT: Pallets_picked;
DISPOSE;

END;
```

B. EXPERIMENT CODE

```
BEGIN;

Project, USNS SAN JOSE UNREP, K. J. Grosskopf, 1995;

ATTRIBUTES:     Timein:
                Origin:        !Defines hold/level origin
                GroupQty:      !Defines Nr pallets on Lift
                Truck#;        !Used to assign Ftrk

COUNTERS:       1, Hold3_count:            !Counts # pallets out of hold 3
                2, Hold4_count:            !4
                3, AftCargo_Count,68:      !Total Pallets for AfterCargo
                4, Pallets_picked;

EXPRESSIONS:    1,, UN(1,1):   !Load 1 pallet  on L3
                2,, UN(2,1):   !Load 2 pallets on L3
                3,, UN(3,1):   !Load 3 pallets on L3
                4,, UN(4,1):   !Remove 1st pallet from L3
```

```
                5,, UN(5,1):    !Remove 2nd pallet from L3
                6,, UN(6,1):    !Remove 3rd pallet from L3
                7,, UN(7,1):    !Trk speed L3 to Fwd1Lane
                8,, UN(8,1):    !Trk speed L4 to Fwd1Lane
                9,, UN(9,1):    !Trk speed Narrow Aisle
                10,, UN(10,1):          !Trk Speed in After cargo
                11,, UN(11,1):          !Time to unload at AftCargo
                12,, UN(12,1):          !Time MD ftrk controls L stage area
                13,, UN(13,1);

PARAMETERS:     1,      .3, .6:
                2,      .6, 1.2:
                3,      .92, 1.84:
                4,      .29, .58:
                5,      .35, .70:
                6,      .37, .74:
                7,      172, 258:
                8,      172, 258:
                9,      172, 258:
                10,     172, 258:
                11,     .27, .54:
                12,     .27, .54:
                13,     .083,.166;

STATIONS:       1, Hold31:      !1-4 =#3, 5-8=#4,9-12=#5
                4, Hold34:
                9, MDatL3:
                10,MDatL4:
                11,L3stage:
                12,L4stage:
                13,Fwd1Lane:
                14,Aft1Lane:
                15,FreeTrk3:
                16,FreeTrk4:
                17,AftCargo;

RESOURCES:      1,Forktrk1__,1:
                2,Forktrk2__,1:
                3,Forktrk3__,1:
                4,Forktrk4__,1:
                5,Forktrk5__,1:
```

```
                6,Forktrk6__,1:
                7,Forktrk7__,1:
                8,Forktrk8__,1:  !Lift cap 1 pallet each hold3
                ForkTrkL3:
                ForktrkL4:
                AftStage,2:
                NAisle,1:
                L3Staging:
                L4Staging:
                Equip3:        !Artificial delays for flow reasons
                Equip4:
                FDE:           !Flight Deck Elevator
                HELO,2;

SETS:           Forktrk,Forktrk1__..Forktrk8__;

QUEUES:         8:
                ForkTrkAft3Q:
                ForkTrkAft4Q:
                Lift3Q:        !, LVF(pri):
                Lift4Q:
                Aisle3Q1:      !Waiting for Aisle going Fwd (empty)
                Aisle3Q3:      !Waiting for Aisle going Aft (Full)
                Aisle4Q1:      !Waiting for Aisle going Fwd (empty)
                Aisle4Q3:      !Waiting for Aisle going Aft (Full)
                GroupQ:
                TempQ:
                L3StageQ1:     !L3Ftrk waiting for L3 stage area
                L3StageQ2:     !FTruckMD waiting for L# stage area
                L4StageQ1:
                L4StageQ2:
                Unload3Q:      !Waiting for L# Ftrk
                Unload3Q1:
                Unload4Q:      !Waiting for L# Ftrk
                Unload4Q1:
                AftCargoQ:
                FDEQ:
                FDQ;

; list pallets pre-stagged pallets in priority sequence, use a
; seperate line for 3 pallet lifts and 1 or 2  pallet lifts|
```

```
;                      qty     origin GpQty  Truck#
;                      |  |  |  |    |   |
ARRIVALS: 1,BLOCK(Startup),0.0, 6,A(1)= .0,A(2)=  1,A(3)=   3,A(4)=    0: ! create
entity
      2,BLOCK(Startup),0.0, 3,A(1)= .0,A(2)=  4,A(3)=   3,A(4)=    0:
      3,BLOCK(Startup),0.0, 9,A(1)= .0,A(2)=  2,A(3)=   3,A(4)=    0:
      4,BLOCK(Startup),0.0, 9,A(1)= .0,A(2)=  3,A(3)=   3,A(4)=    0:
      5,BLOCK(Startup),0.0, 1,A(1)= .0,A(2)=  3,A(3)=   1,A(4)=    0:
      6,BLOCK(Startup),0.0, 12,A(1)= .0,A(2)=  5,A(3)=   3,A(4)=    0: ! create entity
      7,BLOCK(Startup),0.0, 15,A(1)= .0,A(2)=  6,A(3)=   3,A(4)=    0:
      8,BLOCK(Startup),0.0,  9,A(1)= .0,A(2)=  7,A(3)=   3,A(4)=    0:
      9,BLOCK(Startup),0.0,  1,A(1)= .0,A(2)=  7,A(3)=   1,A(4)=    0:
      10,BLOCK(Startup),0.0,  3,A(1)= .0,A(2)=  8,A(3)=   3,A(4)=    0;

SEQUENCES:        1,, Hold31&MDatL3:
                  2,, 2&MDatL3:
                  3,, 3&MDatL3:
                  4,, 4&MDatL3:
                  5,, 5&MDatL4:
                  6,, 6&MDatL4:
                  7,, 7&MDatL4:
                  8,, 8&MDatL4:
                  9,, Aft1Lane&FreeTrk3:
                  10,, Aft1Lane&FreeTrk4;

TALLIES:          1, FWDwait,"fwd.sim":
                  2, T_Time;

OUTPUTS:          TMAX(T_Time),"time.sim",UNREP TIME:
                  DAVG(16),"UTIL.SIM",MDFTUTIL:
                  DAVG(2), "back.sim",BACKLOG AT ELEVATOR #3;

TRANSPORTERS:     1,Lift3,1,1,100,9:     !Elevator from Hold3X to Deck (EL3)
                  2,Lift4,1,1,100,10:    !Elevator from Hold4X to Deck (EL4)
                  3,FTruckMD3,1,2,5,11:       !Flifts from L3Stage to Aft Cargo
                  4,FTruckMD4,2,3,5,12;       !Flifts from L4Stage to Aft Carg

VARIABLES:        GrQty:          !Establishes Nr of pallets on L3
                  TestQty3:
                  TestQty4:
                  MDFTSpeed;
```

```
DSTATS:          NQ(ForkTrkAft3Q),Nr. waiting MDL3 Ftrks,"MDFT3.sim":
                 NQ(ForkTrkAft4Q),Nr. waiting MDL4 Ftrks,"MDFT4.sim":
                 NQ(AftCargoQ), Nr. staged at RASsta10:
                 NQ(Aisle3Q1),Waiting Aisle going Fwd:
                 NQ(Aisle3Q3),Waiting Aisle going Aft:
                 NQ(L3StageQ1),L3Trk wait for L3Stage:
                 NQ(L3StageQ2),MDFtrk wait for L3Stage:
                 NR(1)*100,Util of Ftruck31:
                 NR(2)*100,Util of Ftruck32:
                 NR(3)*100,Util of Ftruck33:
                 NR(4)*100,Util of Ftruck34:
                 NR(5)*100,Util of Ftruck41:
                 NR(6)*100,Util of Ftruck42:
                 NR(7)*100,Util of Ftruck43:
                 NR(8)*100,Util of Ftruck44:
                 NR(ForkTrkL3)*100,Util of FtruckEl3:
                 NR(ForkTrkL4)*100,Util of FtruckEl4:
                 NT(Lift3)*100, Busy Elev 3:
                 NT(FtruckMD3)*100,Busy Forktrkl3:
                 NT(FtruckMD4)*100,Busy Forktrkl4:
                 NQ(FDEQ),Pallets on FD:
                 NR(FDE)*100, Util of FDE;

DISTANCES:       1,9-1-15,9-2-30,9-3-45,9-4-60,
                 10-5-15,10-6-30,10-7-45,10-8-60:
                 2,11-13-175,13-14-60,14-15-35,11-15-100000:
                 3,12-13-20,13-14-60,14-16-35,12-16-1000000;

REPLICATE,       1,0,15000,y,y,0;
                 ;TRACE,,,ns;
END;
```

C. SAMPLE OUTPUT DATA

SIMAN V - License #9999999
Systems Modeling Corporation

Summary for Replication 1 of 1

Project: USS SAN JOSE UNREP
Analyst: K. J. Grosskopf, 1995

Run execution date : 10/22/1995
Model revision date: 10/22/1995

Replication ended at time: 100.439

TALLY VARIABLES

Identifier	Average	Variation	Minimum	Maximum	Observations
FWDwait	--	--	--	--	0
T_Time	34.707	.65031	3.4552	100.43	108

DISCRETE-CHANGE VARIABLES

Identifier	Average	Variation	Minimum	Maximum	Final Value
NW MDL3 Ftrks	8.5289	.61567	.00000	18.000	.00000
NW MDL4 Ftrks	.10666	2.8939	.00000	1.0000	.00000
Nr at RASsta10	.00000	--	.00000	.00000	.00000
W Aisle Fwd	.00745	11.544	.00000	1.0000	.00000
W Aisle Aft	.01906	7.1732	.00000	1.0000	.00000
L3Trk L3Stage	.01045	9.7295	.00000	1.0000	.00000
MDFtrk L3Stag	.00000	--	.00000	.00000	.00000
Util of Ftruck31	2.4658	6.2892	.00000	100.00	.00000
Util of Ftruck32	3.4461	5.2931	.00000	100.00	.00000
Util of Ftruck33	5.2553	4.2459	.00000	100.00	.00000
Util of Ftruck34	1.2385	8.9296	.00000	100.00	.00000
Util of Ftruck41	4.3327	4.6989	.00000	100.00	.00000
Util of Ftruck42	7.6895	3.4647	.00000	100.00	.00000
Util of Ftruck43	4.4497	4.6339	.00000	100.00	.00000
Util of Ftruck44	1.1309	9.3501	.00000	100.00	.00000
Util of FtruckEl3	15.097	2.3714	.00000	100.00	.00000
Util of FtruckEl4	24.127	1.7733	.00000	100.00	.00000
Busy Elev 3	35.947	1.3348	.00000	100.00	.00000
Busy Forktrkl3	98.082	.13983	.00000	100.00	.00000
Busy Forktrkl4	85.348	1.0291	.00000	200.00	.00000
Pallets on FD	26.251	.46970	.00000	38.000	34.000
Util of FDE	96.559	.18875	.00000	100.00	100.00

COUNTERS

Identifier	Count	Limit
Hold3_count	28	Infinite
Hold4_count	40	Infinite
AftCargo_Count	68	68
Pallets_picked	32	Infinite

OUTPUTS

Identifier	Value
UNREP TIME	100.43
MDFTUTIL	15.097
BACKLOG AT ELEVATOR #3	.10666

Execution time: 0.03 minutes.
Simulation run complete.

APPENDIX D. CASREP COUNTS FOR AFS/TAFS

		Casualty Report Category			
Year	Hull	2	3	4	Total
1989	AFS-1	12	3	1	16
	AFS-3	40	3	0	43
	AFS-5	37	3	0	40
	AFS-6	84	6	0	90
	AFS-7	27	6	2	35
	TAFS-8	52	1	0	53
	TAFS-9	26	2	2	30
	TAFS-10	28	0	0	28
Total for 1989:		306	24	5	335

		Casualty Report Category			
Year	Hull	2	3	4	Total
1990	AFS-1	6	2	0	8
	AFS-3	61	13	2	76
	AFS-5	32	8	0	40
	AFS-6	46	6	2	54
	AFS-7	109	11	5	125
	TAFS-8	33	0	2	35
	TAFS-9	29	3	8	40
	TAFS-10	45	4	2	51
Total for 1990:		361	47	21	429

Year	Hull	Casualty Report Category 2	3	4	Total
1991	AFS-1	9	1	0	10
	AFS-3	34	5	0	39
	AFS-5	25	2	1	28
	AFS-6	26	3	0	29
	AFS-7	52	4	2	58
	TAFS-8	42	1	0	43
	TAFS-9	44	1	5	50
	TAFS-10	38	0	0	38
Total for 1991:		270	17	8	295

Year	Hull	Casualty Report Category 2	3	4	Total
1992	AFS-1	34	9	1	44
	AFS-3	64	9	3	76
	AFS-5	25	2	3	30
	AFS-6	29	4	3	36
	AFS-7	52	6	2	60
	TAFS-5	0	1	0	1
	TAFS-7	1	0	0	1
	TAFS-8	13	0	1	14
	TAFS-9	43	0	1	44
	TAFS-10	14	1	0	15
Total for 1992:		275	32	14	321

Note: AFS-5/7 were transferred to MSC during CY 1992

		Casualty Report Category			
Year	Hull	2	3	4	Total
1993	AFS-3	75	18	1	94
	AFS-6	14	1	4	19
	AFS-7	12	4	0	16
	TAFS-1	17	2	1	20
	TAFS-5	99	2	2	103
	TAFS-7	2	0	0	2
	TAFS-8	18	1	1	20
	TAFS-9	33	0	1	34
	TAFS-10	32	1	1	34
Total for 1993:		302	29	11	342

		Casualty Report Category			
Year	Hull	2	3	4	Total
1994	AFS-3	38	7	6	51
	TAFS-1	33	1	1	35
	TAFS-5	83	1	1	85
	TAFS-6	35	5	0	40
	TAFS-8	17	0	0	17
	TAFS-9	13	4	2	19
	TAFS-10	8	2	0	10
Total for 1994:		227	20	10	257

Note: TAFS-7, USNS SAN JOSE undergoing conversion, no reports submitted

		Casualty Report Category			
Year	Hull	2	3	4	Total
1995	TAFS-1	21	1	0	22
	TAFS-5	18	0	0	18
	TAFS-6	26	1	0	27
	TAFS-7	37	4	5	46
	TAFS-8	10	1	1	12
	TAFS-9	13	1	0	14
	TAFS-10	19	0	1	20
Totals for 1995:		144	8	7	159

Note: AFS-3 decommissioned during CY 1994

APPENDIX E. FLIGHT DECK ADDITION DATA

UNREP TIME	MAIN DECK UTILIZATION	BACKLOG AT #3
97.787	15.097	0.10666
99.976	14.162	0.14427
100.36	14.685	0.11500
100.03	13.972	0.13276
98.447	13.984	0.12966
100.03	14.800	0.12421
100.72	14.732	0.10624
98.072	15.158	0.12727
98.894	14.641	0.10536
97.886	14.191	0.12757
96.354	14.218	0.13815
99.143	14.453	0.14147
98.848	15.479	0.12352
98.610	14.564	0.13684
99.293	14.552	0.11279
99.004	14.866	0.13458
98.847	14.203	0.11405
98.353	14.327	0.20427
98.498	14.568	0.11907
98.976	14.880	0.12891
98.766	15.054	0.24668
101.11	14.637	0.12646
98.955	15.236	0.10922
100.13	14.727	0.11269
97.779	14.434	0.11505
97.94	15.015	0.11660
100.05	14.704	0.15282
97.952	15.006	0.11631
97.915	14.935	0.13028
99.48	14.240	0.09858
98.596	14.785	0.11486
96.394	15.568	0.12861
97.459	14.599	0.13801
98.552	15.137	0.10504
98.046	14.755	0.13374
98.186	14.712	0.11201
98.88	14.892	0.14748

	UNREP TIME	MAIN DECK UTILIZATION	BACKLOG AT #3
	100.58	14.499	0.12240
	98.873	14.845	0.13137
	98.391	15.252	0.15829
	101.538	14.578	0.10167
	99.038	14.186	0.13777
	98.694	14.649	0.11723
	98.575	14.798	0.16334
	101.07	14.808	0.14079
	99.14	14.764	0.15750
	98.256	14.525	0.13206
	99.611	14.570	0.14799
	95.88	14.892	0.11663
	100.58	14.499	0.14748
	98.873	14.845	0.12240
	98.392	15.252	0.13137
	105.538	14.578	0.15829
	99.038	14.186	0.10167
	98.694	14.649	1.37770
	98.575	14.798	0.11723
	101.07	14.808	0.16334
	99.14	14.764	0.14079
	98.256	14.525	0.15750
	99.611	14.570	0.13206
Ave:	**99.029**	**14.697**	**0.152566**

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